

The AgMIP Framework to Evaluate Agricultural Pathways



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Views expressed are those of the author, and don't necessarily represent those of NASA



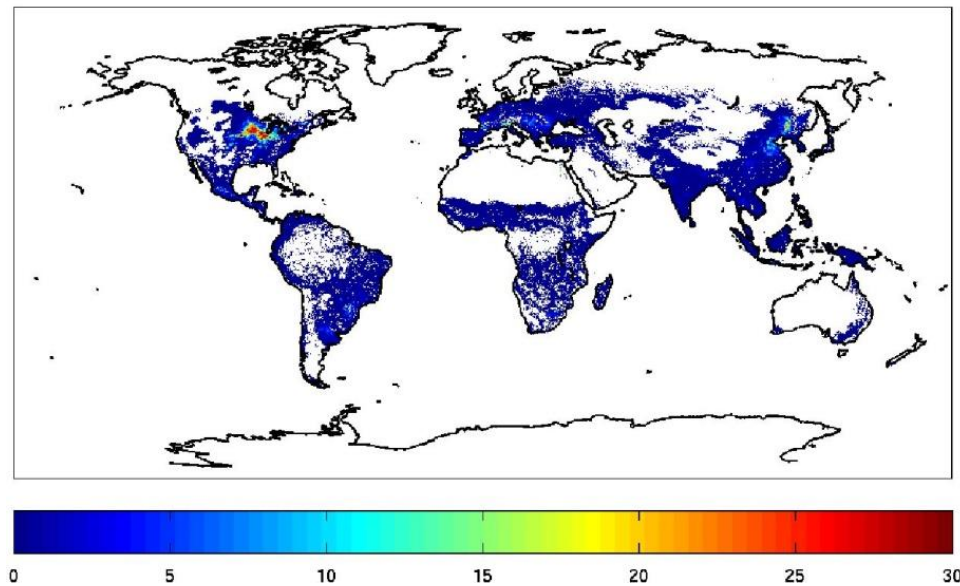
Goddard Institute for Space Studies
New York, N.Y.



CENTER FOR CLIMATE
SYSTEMS RESEARCH

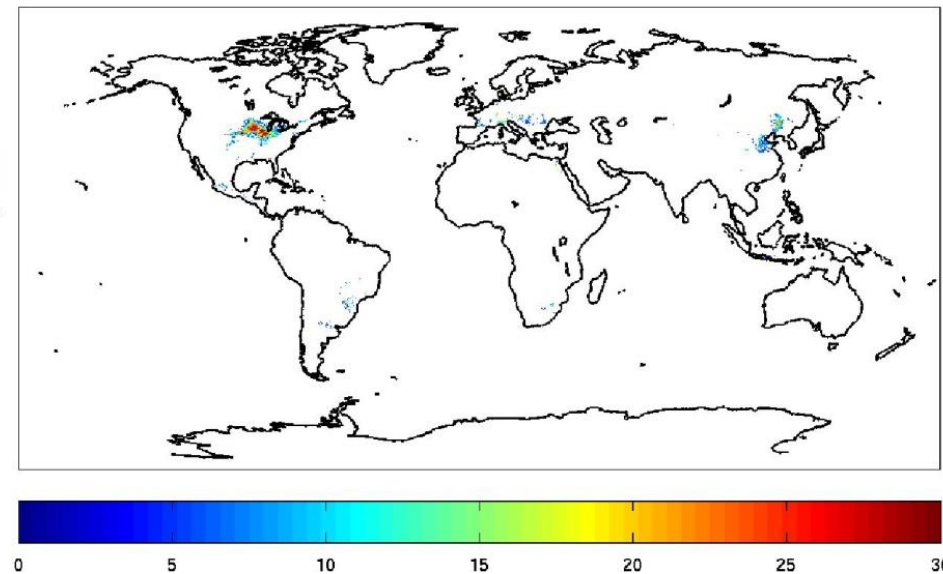
THE EARTH INSTITUTE AT COLUMBIA UNIVERSITY

All Maize Production (1000s of kg)



Data from Monfreda et al., 2002

Top Regions Accounting for 90% of World Maize Production



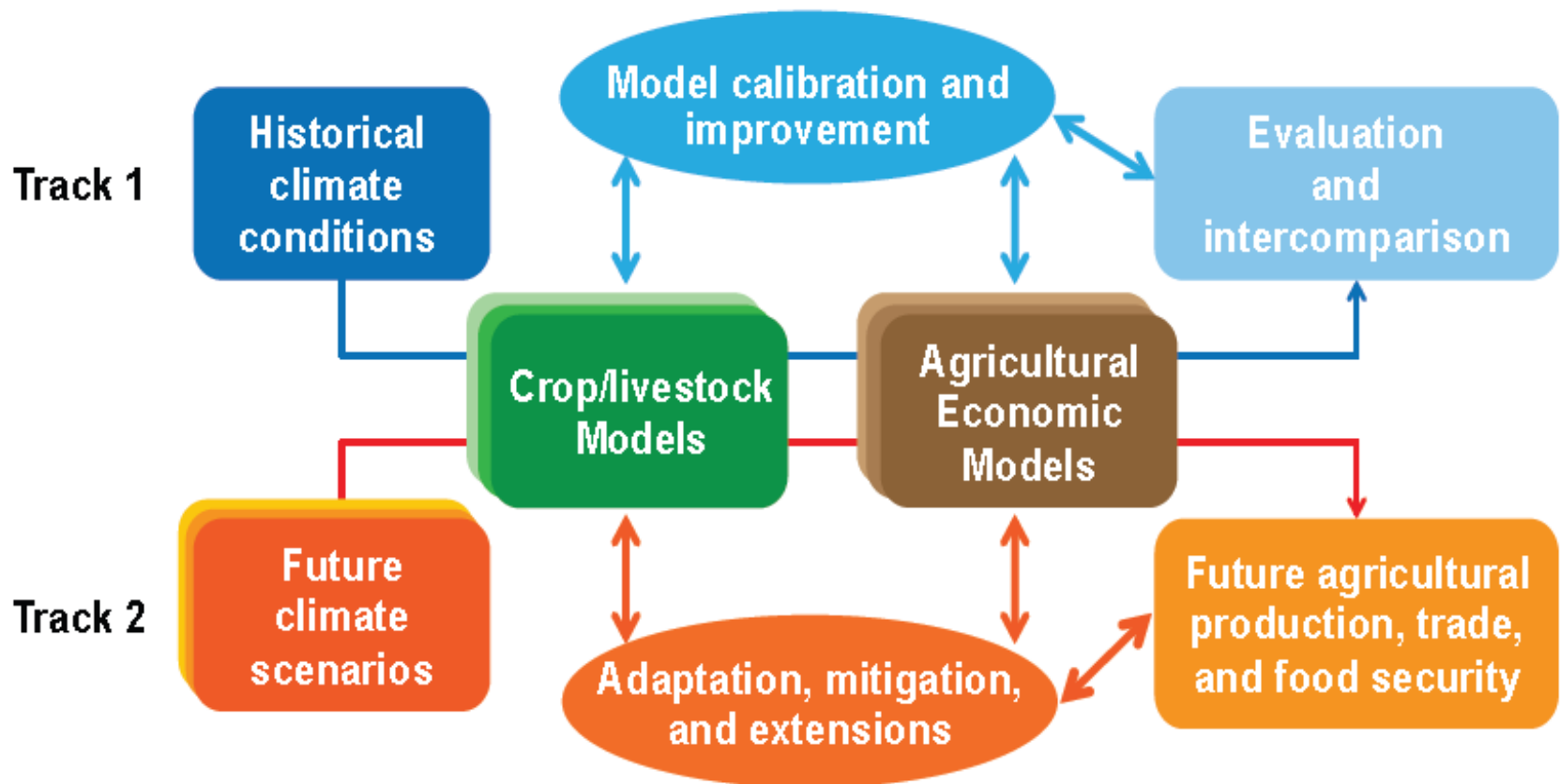
The image shows a vibrant, terraced agricultural landscape. In the foreground, there are lush green rice paddies. To the left, a dense patch of tall corn plants stands out. Three people are visible in the lower-middle ground, working in the rice fields; one is wearing a white shirt and a light-colored hat, while the other two are in red clothing. The background consists of more terraced fields, some with corn and others with rice, leading up to a dense forest of tall trees. The overall scene is a healthy, productive agricultural environment.

The Agricultural Model Intercomparison and Improvement Project (AgMIP)

Provide effective **science-based agricultural decision-making models and assessments** of **climate variability and change** and **sustainable farming systems** to achieve **local-to-global food security**



Near Arusha, Tanzania



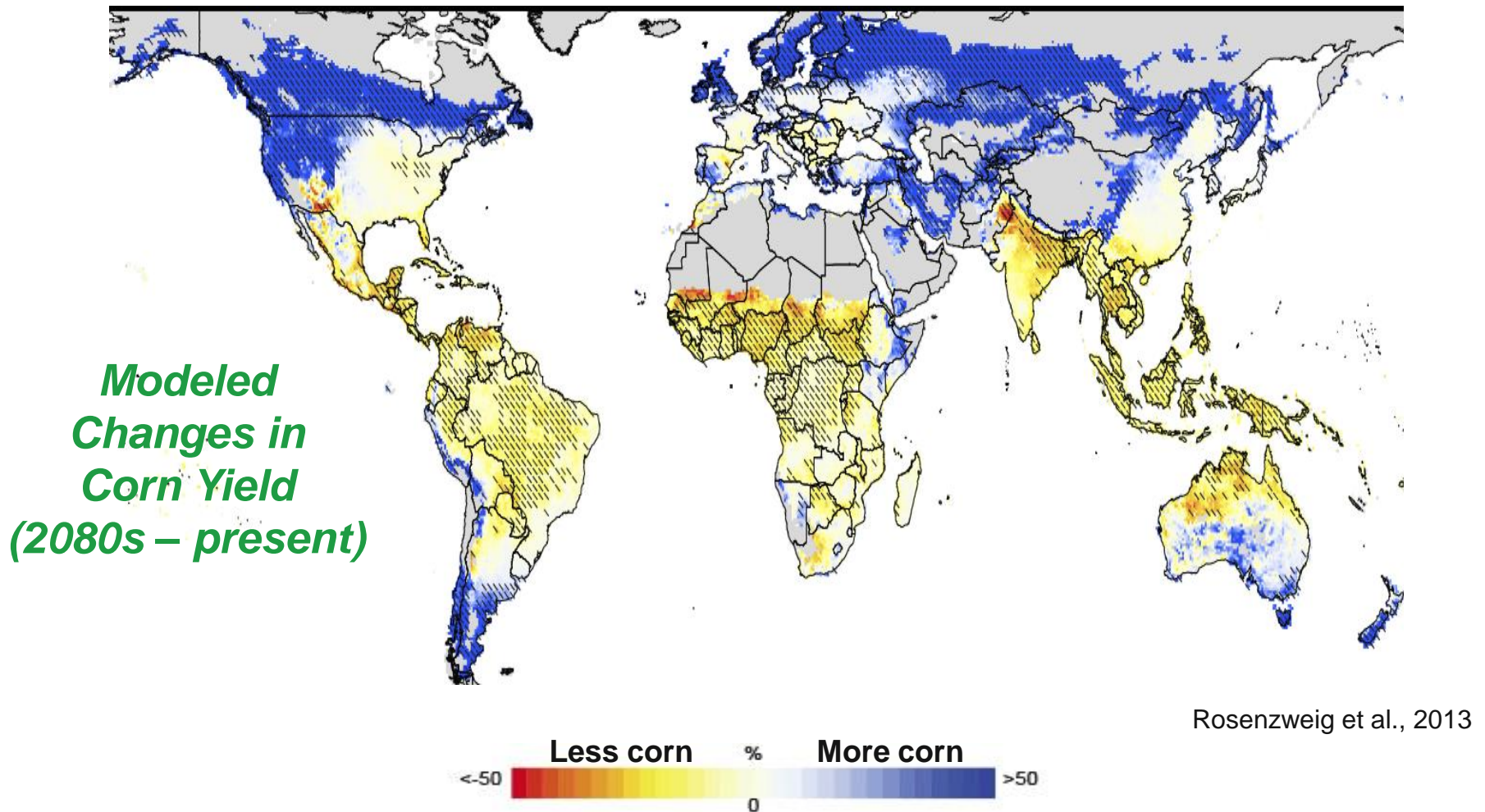
Rosenzweig et al., 2013 AgForMet

Current AgMIP Activities



Visit www.agmip.org
for more information
and to sign up for
AgMIP listserv

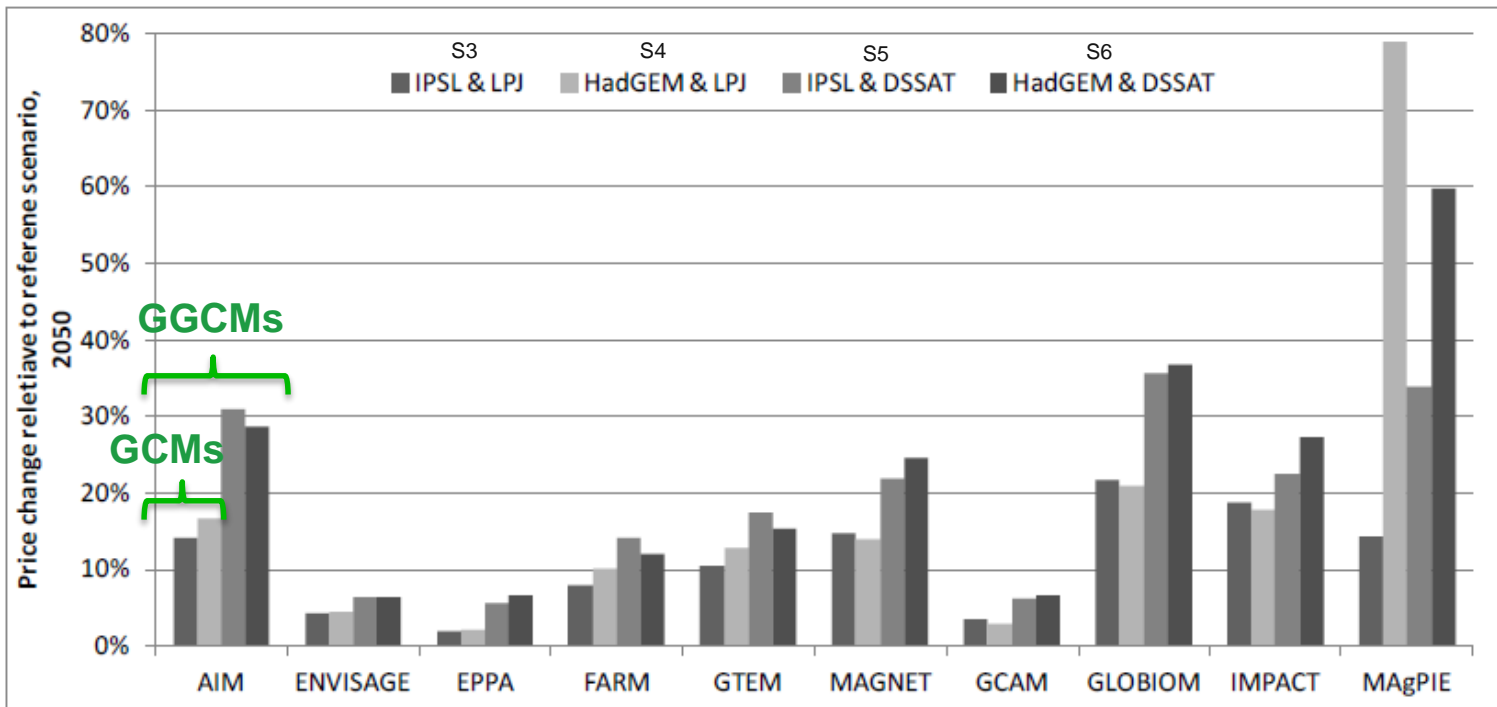
Yield impacts most severe in tropical regions



5 GCMs, 7 GGCMs; hatched = 70% agreement in sign of change

Global Economics Models Suggest Upward Pressure on Prices

Effects of climate change on agricultural prices (2050 RCP8.5 relative to results without climate change in 2050)



Source: Model results as of February 15, 2013

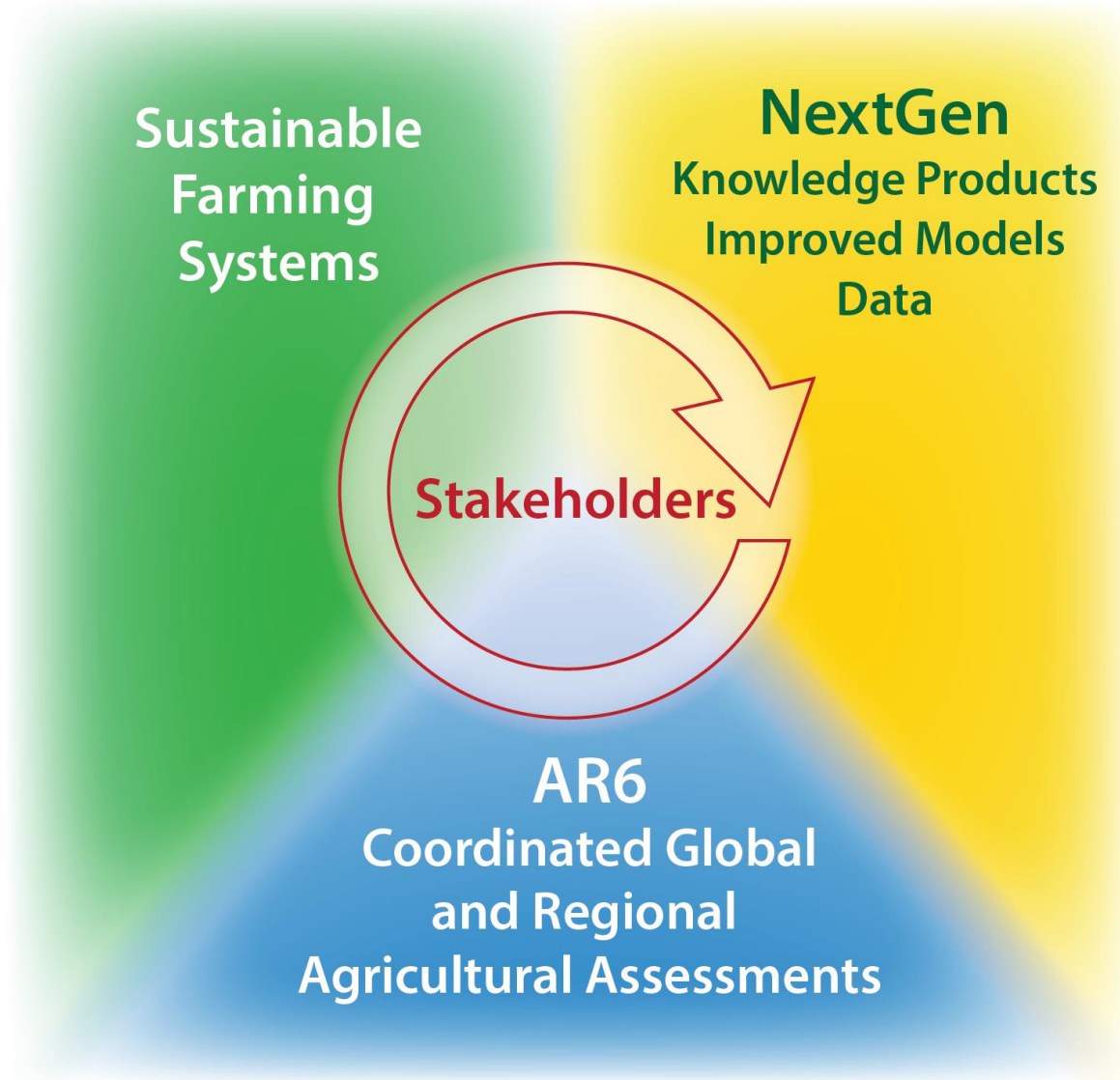
Note: All changes relative to the reference scenario for the same year.

AgMIP Global Economics Model Intercomparison

10 Global Economics Models, 2 GCMs, 2 crop models

Von Lampe et al., *Agricultural Economics*, 2013

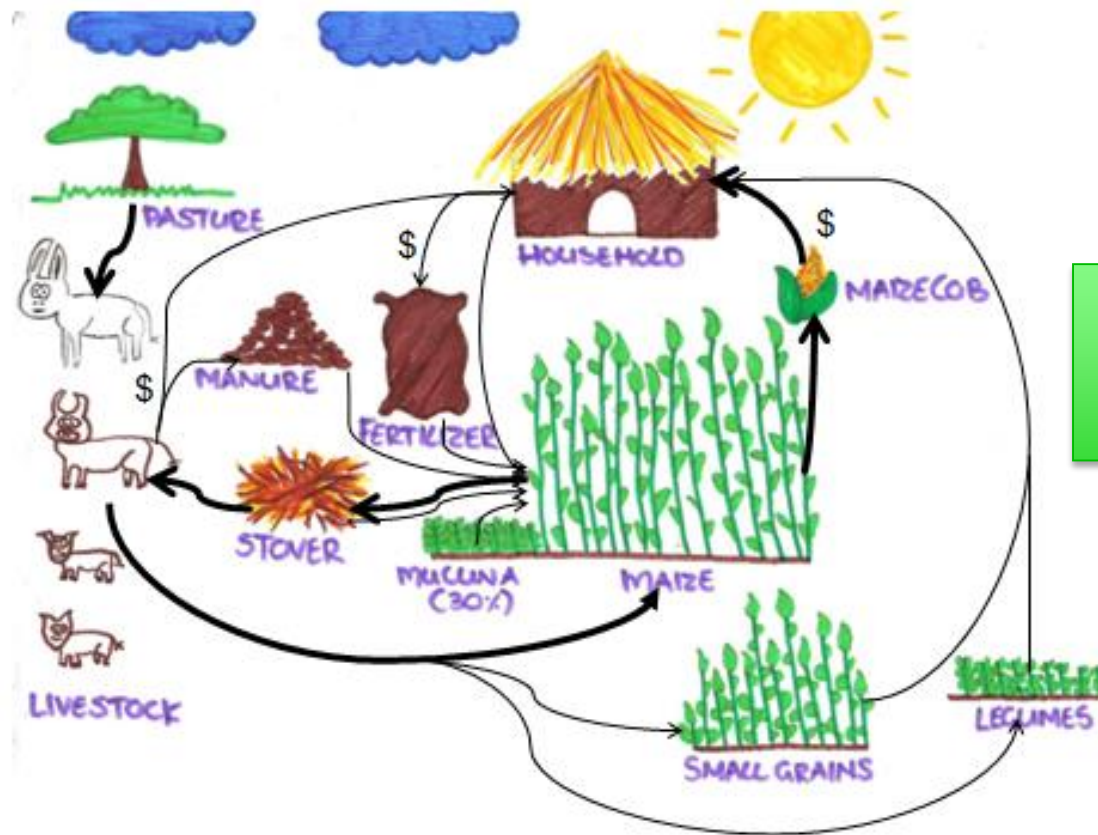
Baseline from SSP2



Constructing a Regional Modeling Framework



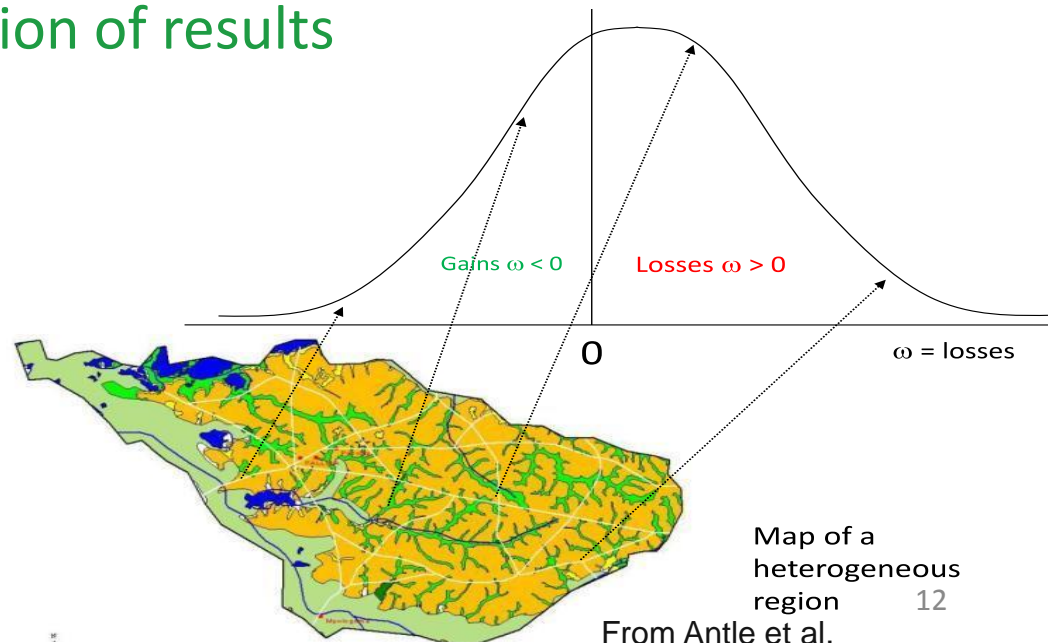
Resource
and
Technology
Inputs



Environmental
Social and
Economic
Outcomes

Benefits of Regional Integrated Assessment Approach

- Involves local experts from all disciplines but maintains connection to global markets and pressures
 - More attention to calibration toward local conditions
 - Greater interest in analysis by participating regions
- Better awareness of relevant datasets by including local partners
- Greater engagement with stakeholders in project and scenario design as well as dissemination of results
- Examines impacts across distribution of farm systems (rather than assuming all farms are represented within a given grid box or polygon)

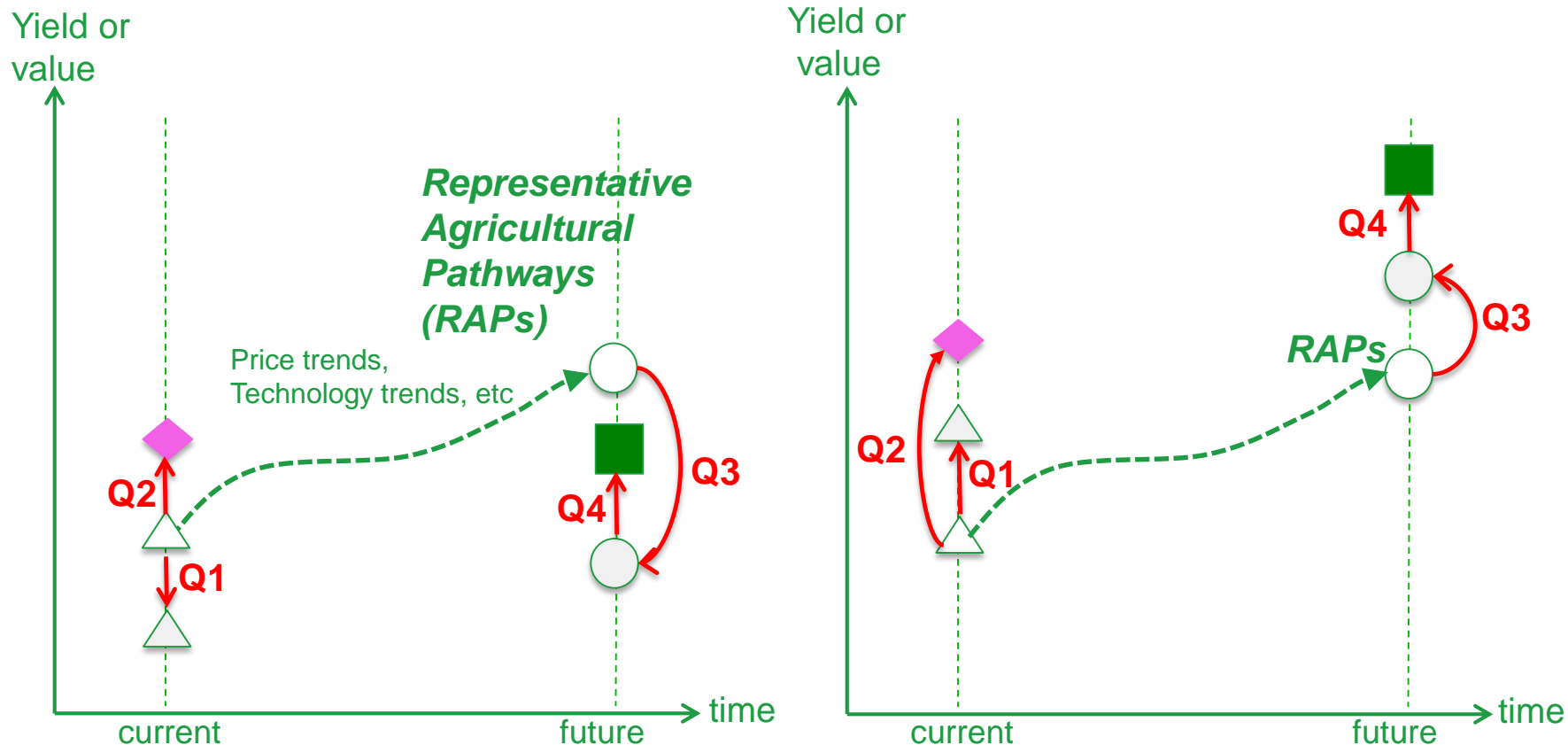


Representative Agricultural Pathways

Storylines of our Agricultural Future



The AgMIP Regional Integrated Assessment Core Research Questions:



Q1: What is the sensitivity of current agricultural production systems to climate change? This question addresses the isolated impacts of climate changes assuming that the production system does not change from its current state.

Q2: What are the benefits of adaptation in current agricultural systems? This question addresses the benefit (e.g., economic and food security resilience) of potential adaptation options to current agricultural systems given current climate

Q3: What is the impact of climate change on future agricultural production systems? Assessment of climate impacts on the future production system, which will differ from the current production system due to development in the agricultural sector

Q4: What are the benefits of climate change adaptations? Assessment of the benefits of potential adaptation options in the future production system

RAPs vary by location (Zimbabwe example)

Indicators	Pessimistic RAP1.1 If there is no change of mindset and way of doing business, food security situation will continue to worsen		Optimistic RAP 1.2 Favorable conditions for private and public investments in the agricultural sector will be created	
Degradation	+++	Extractive land use	--	Investments in NRM, secure ownership
Size of cultivated land	--	Lack of labor, limited investment options	--	Intensified production on less land
Herd size	--	Shift towards goats	++	Improved feed and management
Input prices	+++	Lack of local manufacturing and raw material	++	More players in processing industry against higher demand for inputs
Input use	---	Lack of affordability and returns	++	Market incentives, investment security, appropriate support
Crop income	---	Low local production and competition with cheap imports	++	Increased income from higher production
Livestock income	---	Competition with cheap imports	++	High and unmet demand for livestock products Improved quality production
Crop – livestock product imports	+++	While national production is declining, the demand actually increases	+/-	Large potential to produce vs climatic risks (droughts, no national reserves)
Off-farm income	---	Alternative income options are also limited	--	High farm productivity will keep more people in agriculture

Table shown as an example, please do not cite

Masikati et al.; AgMIP: CLIP RRT -Zimbabwe

AgMIP Regional Research Teams RAPs Trends Table: SSA (AgMIP, Phase I)

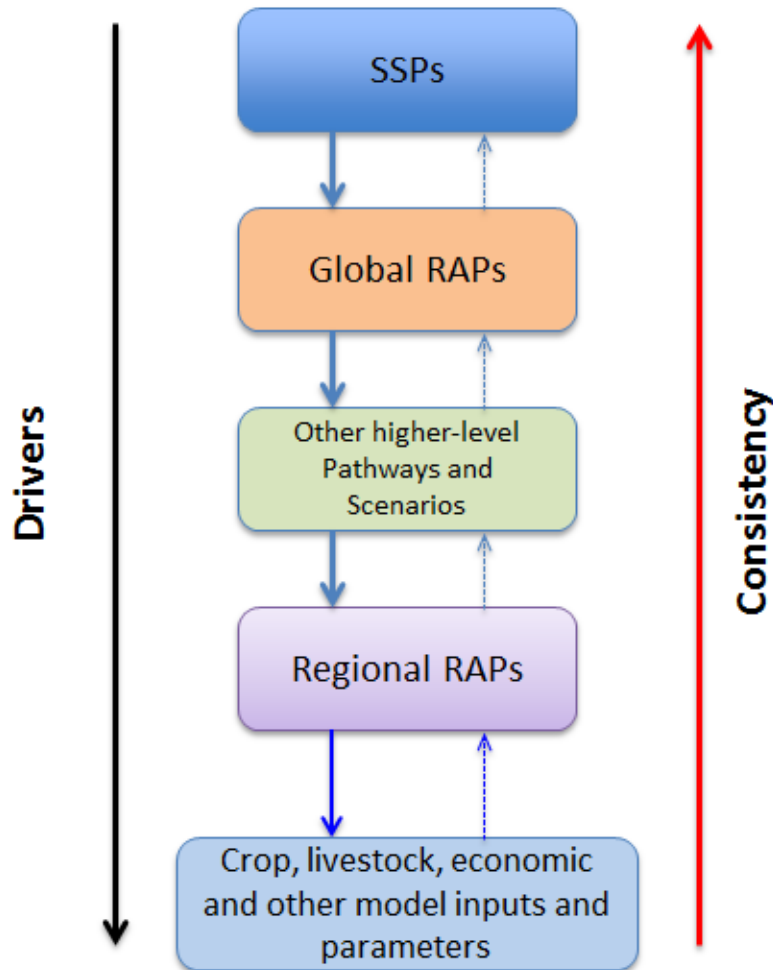
Variable	CLIP – R1 Zimb	CLIP – R2 Zimb	CLIP – R1 Mozamb	CLIP – R2 Mozamb	East Africa Embu, KE	West Africa R1 Niore	West Africa R2 Niore	SAAMIP South Africa	SAAMIP Namibia
Soil degradation									
Pest and diseases									
Extreme events									
Water availability									
Farm size									
Household size									
Herd size									
Livestock Productivity									
Fertilizer prices									
Fertilizer use									
Subsidies (inputs)									
Off-farm income									
Improved crop use									
Information availability									
Public invest in Agriculture									
Labor availability									

Direction and magnitude	
No change	
Small increase	
Moderate increase	
Large increase	
Small decrease	
Moderate decrease	
Large decrease	
Not included in RAP or under revision	

BAU Pessimistic

SSP2, period 2050

Linking Agriculture-Specific Pathways to SSPs: Representative Agricultural Pathways (RAPs)



-> **Hierarchical structure (nested approach)**

. SSPs: Framework for development of sectoral (e.g. agricultural) global and regional scenarios.

- Global RAPs: Global Economic Models and other non-modeled global socio-economic conditions:
 - GDP, population & policy and trade, etc
- Regional RAPs: Allow us to include key drivers are likely to affect future bio-physical and socio-economic conditions:
 - ag productivity trends, land use, policy, regional development
 - farm size, system-specific productivity & management, infrastructure, etc

AgMIP:
*Developing and implementing
Representative Agricultural Pathways and
Scenarios (RAPs)*

AgMIP's Community and Integrated Framework as Resources for Sustainable Solutions





1st Global Oct 2010



2nd Global Oct 2011



4th Global Oct 2013



5th Global Feb 2015



Sub-Saharan Africa #3



South Asia #3



3rd Global Oct 2012

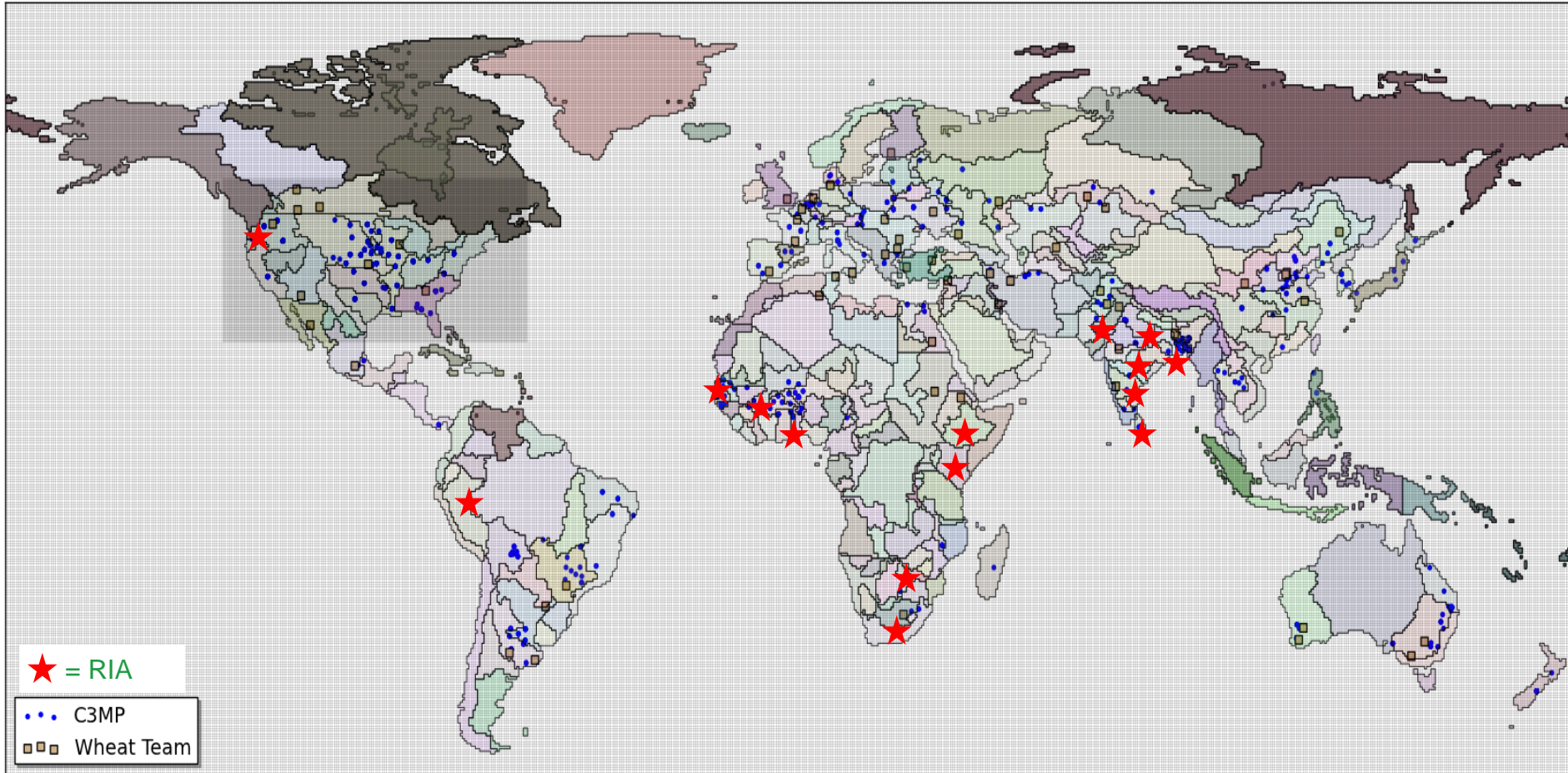
Rising temperatures reduce global wheat production

S. Asseng^{1*}, F. Ewert², P. Martre^{3,4}, R. P. Rötter⁵, D. B. Lobell^{6,7}, D. Cammarano¹¹, B. A. Kimball⁸, M. J. Ottman⁹, G. W. Wall⁸, J. W. White⁸, M. P. Reynolds¹⁰, P. D. Alderman¹⁰, P. V. V. Prasad¹¹, P. K. Aggarwal¹², J. Anothai¹³, B. Basso^{14,15}, C. Biernath¹⁶, A. J. Challinor^{17,18}, G. De Sanctis¹⁹, J. Doltra²⁰, E. Fereres²¹, M. Garcia-Vila²¹, S. Gayler²², G. Hoogenboom¹³, L. A. Hunt²³, R. C. Izaurralde^{24,25}, M. Jabloun²⁶, C. D. Jones²⁴, K. C. Kersebaum²⁷, A.-K. Koehler¹⁷, C. Möller²⁸, S. Naresh Kumar²⁹, C. Nendel²⁷, G. O'Leary³⁰, J. E. Olesen²⁶, T. Palosuo⁵, E. Priesack³⁶, E. Eyshi Rezaei², A. C. Ruane³¹, M. A. Semenov³², I. Shcherbak^{14,15}, C. Stöckle³³, P. Stratonovitch³², T. Streck³⁴, I. Supit³⁵, F. Tao^{6,36}, P. J. Thorburn³⁷, K. Waha²⁸, E. Wang³⁸, D. Wallach³⁹, J. Wolf³⁵, Z. Zhao^{38,40} and Y. Zhu⁴¹

Chapter 8

The AgMIP Coordinated Climate-Crop Modeling Project (C3MP): Methods and Protocols

Sonali P. McDermid^{1,2}, Alexander C. Ruane², Cynthia Rosenzweig², Nicholas I. Hudson³, Monica D. Morales³, Prabodha Agalawatte⁵⁵, Shakeel Ahmad⁶⁰, L. R. Ahuja⁴, Istiqlal Amien⁵⁴, Sasendran S. Anapalli⁴, Jakarat Anothai⁵, Senthod Asseng⁶, Jody Biggs⁶³, Federico Bert⁸, Patrick Bertuzzi⁹, Virender S. Bhatia¹⁰, Marco Bindi¹¹, Ian Broad¹², Davide Cammarano¹³, Ramiro Carretero⁸, Ashfaq Ahmad Chattha⁵⁰, Uran Chung¹⁴, Stephanie Debats⁵⁶, Paola Deligios⁶⁴, Giacomo De Sanctis¹⁵, Thanda Dhlwayo¹⁴, Benjamin Dumont⁷, Lyndon Estes⁵⁶, Frank Ewert¹⁶, Roberto Ferrise¹¹, Thomas Gaiser¹⁶, Guillermo Garcia⁸, Sika Gbegbelegbe¹⁷, Vellingiri Geethalakshmi¹⁸, Edward Gerardeaux¹⁹, Richard Goldberg³, Brian Grant²⁰, Edgardo Guevara²¹, Jonathan Hickman²², Holger Hoffmann¹⁸, Huanping Huang²³, Jamshad Hussain⁵⁰, Flavio Barbosa Justino²⁴, Asha S. Karunaratne²⁵, Ann-Kristin Koehler²⁶, Patrice K. Kouakou⁶¹, Soora Naresh Kumar²⁷, Arunachalam Lakshmanan¹⁸, Mark Lieffering⁵⁷, Xiaomao Lin²⁸, Qunying Luo²⁹, Graciela Magrin²¹, Marco Mancini¹¹, Fabio Ricardo Marin⁵², Anna Dalla Marta¹¹, Yuji Masutomi³⁰, Theodoros Mavromatis³¹, Greg McLean³², Santiago Meira²¹, Monoranjan Mohanty³³, Marco Moriondo¹¹, Wajid Nasim⁶⁰, Lamyaa Negm³⁴, Francesca Orlando¹¹, Simone Orlandini¹¹, Isik Ozturk³⁵, Helena Maria Soares Pinto⁵², Guillermo Podesta⁵³, Zhiming Qi³⁶, Johanna Ramarohetra³⁷, Muhammad Habib ur Rahman⁵⁰, Helene Raynal³⁸, Gabriel Rodriguez²¹, Reimund Rötter⁵⁸, Vaishali Sharda⁶, Lu Shuo³⁹, Ward Smith²⁰, Val Snow⁵⁹, Afshin Soltani⁴⁰, K. Srinivas⁴¹, Benjamin Sultan⁶⁶, Dillip Kumar Swain⁴², Fulu Tao⁴³, Kindie Tesfaye⁴⁴, Maria I. Travasso²¹, Giacomo Trombi¹¹, Alex Topaj⁶⁵, Eline Vanuytrecht⁵¹, Federico E. Viscarra⁴⁵, Syed Aftab Wajid⁵⁰, Enli Wang⁴⁶, Hong Wang⁴⁷, Jing Wang³⁹, Erandika Wijekoon⁵⁵, Lee Byun-Woo⁴⁸, Yang Xiaoguang³⁹, Ban Ho Young⁴⁸, Jin I. Yun⁴⁹, Zhigan Zhao³⁹, and Lareef Zubair⁵⁵



Grids = Global and regional crop models; Polygons = Food-producing units

TOA-MD has 100+ users around the world; ~800 AgMIP Participants

Concluding Thoughts



- **AgMIP Projects and Partners use cutting-edge model, data, and IT approaches to understand resilience, sustainability, and productivity of farming systems and agricultural economies in support of stakeholder decisions from regional to global scales.**
 - **Models can be used for both climate change and broader sustainability studies**
- **The AgMIP community has grown in the last 5+ years, and participants are eager to demonstrate the use of models for the testing of sustainable solutions and informed decision making**
- **AgMIP tools could play a role in identifying and prioritizing sustainable approaches in diverse communities.**

Also:

- **AgMIP is planning a Coordinated Global and Regional Assessment of Climate Change Impacts on Agriculture and Food Security with an aim to inform the IPCC Sixth Assessment Report.**

A photograph of a large-scale center pivot irrigation system in a field. A long, straight line of white pipes stretches across the landscape, with a single pivot point visible on the right. A bright rainbow arches across the sky above the pipes. The foreground is filled with golden-brown wheat, while the background shows a line of green trees and distant blue mountains under a blue sky with scattered white clouds.

Thanks!

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